REMARKS

At the outset, the Examiner is thanked for the thorough consideration given the subject application. The Final Office Action mailed December 16, 2002 has been received and its contents carefully reviewed. Reconsideration and reexamination are respectfully requested.

Claims 1-13, 16-19, 22, and 24-41 are currently pending in this application. Claims 1, 2, 16, and 22 have been amended; and claims 14 and 15 have been canceled.

The Examiner rejected claims 1-5, 10-13, and 16-19 under 35 USC § 102 (a and e) as being clearly anticipated by Makita et al. (US Patent No. 5,851,860); and rejected claims 7-9, 14, 15, 22, and 34-41 under 35 USC § 103(a) as being unpatentable over Makita et al. (US Patent No. 5,851,860. These rejections are respectfully traversed.

Claims 1 and 2 are allowable at least for the reason that claims 1 and 2 recite a combination of elements including depositing an inducing substance for silicon crystallization on an exposed surface of an amorphous silicon layer by plasma exposure; and annealing the amorphous silicon layer wherein the plasma exposure is carried out for about 0 to 1000 seconds and under the pressure of about 0.5 mTorr ~ 100Torr. None of the cited references teaches or suggests each and every feature of the claims or teaches or suggests singly, or in combination, at least these features of the claims.

As described on pages 7 and 8 of the specification of this application, "the amount of metal of the plasma-exposed layer is controlled by adjusting RF or DC power, time during which the amorphous silicon layer is exposed to plasma, or deposition pressure." Further, on page 10, "[m]etal contamination of the crystallized layer is substantially reduced by adjusting the amount of metal in the layer in accordance with plasma exposure time."

In contrast, Makita et al. may teach that a catalyst may be added to the amorphous silicon film using plasma process, but the reference fails to disclose implicitly or explicitly the

time and pressure parameters recited in the independent claims. The reference fails to teach that these parameters are critical for controlling the amount of catalyst. Applicants provide the paragraphs in Makita et al. in which plasma processing and controlling the amount of catalyst are discussed below:

At column 23, lines 19-42, Makita et al. discloses:

> "In the above-described two production methods developed by the present inventors, the catalyst element can be introduced by an ion implantation, a very small amount of catalyst element can be introduced by forming a super-thin film by a sputtering technique, or added by a plasma processing. The plasma processing is a method for adding a catalyst element to the amorphous silicon film using a plasma CVD apparatus in which the electrode is made of a material containing a catalyst element and plasma is generated under a nitrogen or a hydrogen ambient gas. In the case of introducing the catalyst element into the amorphous silicon film by these methods, the catalyst element has already penetrated into a considerable depth of the amorphous silicon film before conducting the heat-treatment, and simultaneously, the catalyst element has penetrated into a considerable depth of the insulating thin-film serving as a mask. In order to use an insulating thin-film serving as a mask during one process as a part of the device during a subsequent process, it is important to introduce the catalyst element only into an extremely thin surface region of the amorphous silicon film, and the insulating thin-film or the diffusion barrier film. Therefore, the above-described method for introducing the catalyst element can not be regarded as an optimal one."

According to the last sentence of this paragraph, it appears that plasma processing is not a preferred method of introducing the catalyst element in Makita et al.

At column 33, lines 50-67, Makita et al. discloses:

> As shown in FIG. 7B, a super-thin nickel film 505 is grown by a deposition method. This nickel film is too thin a film to be seen with the eyes, and the amount of the deposition is controlled by the surface density of nickel. In this example, the surface density of nickel to be deposited is set to be 2.times.10.sup.13 cm.sup.-2. This super-thin nickel film 505 is annealed at a temperature of 520.degree. to 580.degree. C. for several to several tens of hours, e.g., 550.degree. C. for 16 hours, under a hydrogen or an inactive ambient gas so as to be crystallized.

It appears that the method described in this paragraph, which appears to be a method other than plasma processing, controls the amount of the deposition [emphasis added] by the surface density of nickel.

At column 33, lines 50-67, Makita et al. discloses:

> "In the above-described examples, in order to introduce selectively a small amount of nickel, a method in which a nickel-based aqueous solution is applied to the surface of the amorphous silicon film, or a method for forming a nickel super-thin film (thin enough to be only faintly observable as a film) are employed. A method for selectively introducing nickel ions to the amorphous silicon film by an ion doping method can also be employed as a method for adding nickel and thereby obtaining an advantage of controlling the concentration of nickel. In place of forming a nickel thin film, a small amount of nickel can be added by performing a plasma processing using Ni electrodes. As catalyst elements to be doped as impurities for promoting the crystallization of the amorphous silicon film other than nickel, cobalt, palladium, platinum, copper, silver, gold, indium, tin, aluminum, phosphorus, arsenic, or antimony can also be employed. The same effects can be obtained in such cases, too."

The reference does not recognize that time and pressure are a function of the amount of catalyst, and therefore the parameters optimized in this application should not be recognized in the art to be result-effective variables. See MPEP 2144.

Applicants respectfully submit that Makita et al. does not teach each and every feature of the claim, namely the parameters of time and pressure.

Applicants respectfully submit that the Examiner has failed to establish a *prima facie* case of obviousness since Makita et al. teaches away from the invention in that plasma exposure is not an optimal method of depositing a catalyst on an exposed surface of an amorphous silicon layer,\.

Makita et al. does not teach or suggest the claimed invention as a whole. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 218 USPQ 871 (Fed. Cir. 1983); *Schenck v. Nortron Corp.*, 713 F.2d 782, 218 USPQ 698 (Fed. Cir. 1983); see also *In re Hirao*, 535 F.2d 67, 190 USPQ 15 (CCPA 1976).

Makita et al. is not attempting to solve similar problems with the same solution. "[A] patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the 'subject matter as a whole', which should always be considered in determining the obviousness of an invention under 35 U.S.C. § 103." *In re Sponnoble*, 405 F.2d 578, 585, 160 USPQ 237, 243 (CCPA 1969).

However, "discovery of the cause of a problem . . . does not always result in a patentable invention. . . . [A] different situation exists where the solution is obvious from prior art which contains the same solution for a similar problem." *In re Wiseman*, 596 F.2d 1019, 1022, 201 USPQ 658, 661 (CCPA 1979) (emphasis in original).

Applicants submit that the rejection of independent claims 1 and 2 under 35 USC 102 should be withdrawn as the features of claims 14 and 15, which were rejected under 35 USC 103, have been included in the independent claims. For similar reasons, claims 16 and 22 are likewise deemed to be allowable over the cited references.

Moreover, claims 3-13, 17-19, and 24-41 are allowable as being dependent on claims 1, 2, 16, and 22, which are believed to be allowable.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned **"Version with markings to show changes made."**

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

Should the Examiner deem that a telephone conference would further the prosecution of this application; the Examiner is invited to call the undersigned attorney at (202) 496-7371.

If these papers are not considered timely filed by the Patent and Trademark Office, then a petition is hereby made under 37 C.F.R. §1.136. Please credit any overpayment to deposit Account No. 50-0911.

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Respectfully submitted,

By _____

Teresa M. Arroyo
Registration No.: 50,015
MCKENNA LONG & ALDRIDGE LLP
1900 K Street, N.W.
Washington, DC 20006
(202) 496-7500
Attorneys for Applicant

Version With Markings to Show Changes Made

In the Claims

Please amend the claims as follows:

1. (Amended) A method of crystallizing amorphous silicon, comprising:

depositing an inducing substance for silicon crystallization on an exposed surface of an amorphous silicon layer by plasma exposure; and

annealing the amorphous silicon layer,

wherein the plasma exposure is carried out for about 0 to 1000 seconds and under the pressure of about 0.5 mTorr ~ 100Torr.

2. (Amended) A method of crystallizing amorphous silicon, comprising:

providing a substrate on which an amorphous silicon layer is formed;

depositing an inducing substance for silicon crystallization on an exposed surface of an amorphous silicon layer by plasma exposure; and

annealing the amorphous silicon layer,

wherein the plasma exposure is carried out for about 0 to 1000 seconds and under the pressure of about 0.5 mTorr ~ 100Torr.

16. (Amended) A method of crystallizing amorphous silicon, comprising:

depositing an inducing substance for silicon crystallization on an amorphous silicon layer by plasma exposure while annealing is carried out on the amorphous silicon layer,

wherein the plasma exposure is carried out for about 0 to 1000 seconds and under the pressure of about 0.5 mTorr ~ 100Torr.

22. (Amended) A crystallizing apparatus, comprising:

a chamber having inner space;

a substrate support arranged in the chamber, the substrate support being used for supporting a substrate having an amorphous silicon layer formed thereon;

a plasma generating device having a metal source connected to a power supply, the plasma generating device producing plasma inside the chamber by supplying the metal bar with RF or DC power from the power supply to deposit a crystallization catalyst on an exposed surface of the amorphous silicon layer;

a heater arranged at the substrate support, the heater supplying the substrate with heat for performing crystallization while the plasma generating device produces plasma inside the chamber,

wherein the plasma exposure is carried out for about 0 to 1000 seconds and under the pressure of about 0.5 mTorr ~ 100Torr.